

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

WASTE TREATMENT LAGOON

(No.)

CODE 359

DEFINITION

An impoundment made by excavation or earthfill for biological treatment of animal or other agricultural waste.

PURPOSE

This practice may be applied as part of a resource management system to support the following:

- ☐ To biologically treat organic waste.
- ☐ To reduce pollution and protect the environment.

CONDITIONS WHERE PRACTICE APPLIES

This practice standard establishes the minimum acceptable requirements for design, construction, and operation of waste treatment lagoons. Embankments are limited to an effective height of 10.7 m (35 ft) or less and to hazard class (a). This standard does not apply to Waste Storage Ponds or to Waste Storage Structures.

This practice applies where:

1. an overall waste management system has been planned;
2. waste generated by agricultural production or processing needs treatment;
3. a lagoon can be located near the source of the waste and a minimum of 91 m (300 ft) from a neighboring residence or public area;
4. soils are suitable for retaining the waste or

can be sealed; and

5. A water supply is adequate to fill the lagoon about half full before operation and to maintain the design depth when the lagoon becomes fully operational.

CRITERIA

General criteria applicable to all purposes

Soil and foundation

The pond shall be located in soils with acceptable permeability, or the pond shall be lined. In accordance with Washington guidelines, the minimum seepage criteria for waste storage facilities are a permeability of less than 10⁻⁷ centimeters per sec and a specific discharge less than 1/8th of an inch per day. Chapter 7 of the Agricultural Waste Management Field Handbook (AWMFH) shall be used to address seepage and groundwater considerations for the design of ponds

Waste production

Waste treatment lagoons are designed on the basis of 5-day biochemical oxygen demand (BOD₅) or volatile solids (VS) loading. Design loading shall be based on the maximum weight of animals using the lagoon and on other waste introduced. Information on waste production is provided in Chapter 4 of the Agricultural Waste Management Field Manual. Reliable local determinations should be used if available.

Loading

Anaerobic waste treatment lagoons are designed on the basis of daily VS loading per 1,000 ft³ of lagoon

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volume. Maximum loading shall be as indicated in figure 1 or according to state regulatory requirements, whichever is more stringent. If a high degree of odor control is necessary, loading rates should be decreased.

Naturally aerobic lagoons are designed on the basis of daily BOD₅ loading per hectare (acre) of lagoon surface. Allowable loading shall be as indicated in figure 2 or according to state regulatory requirements, whichever is more stringent.

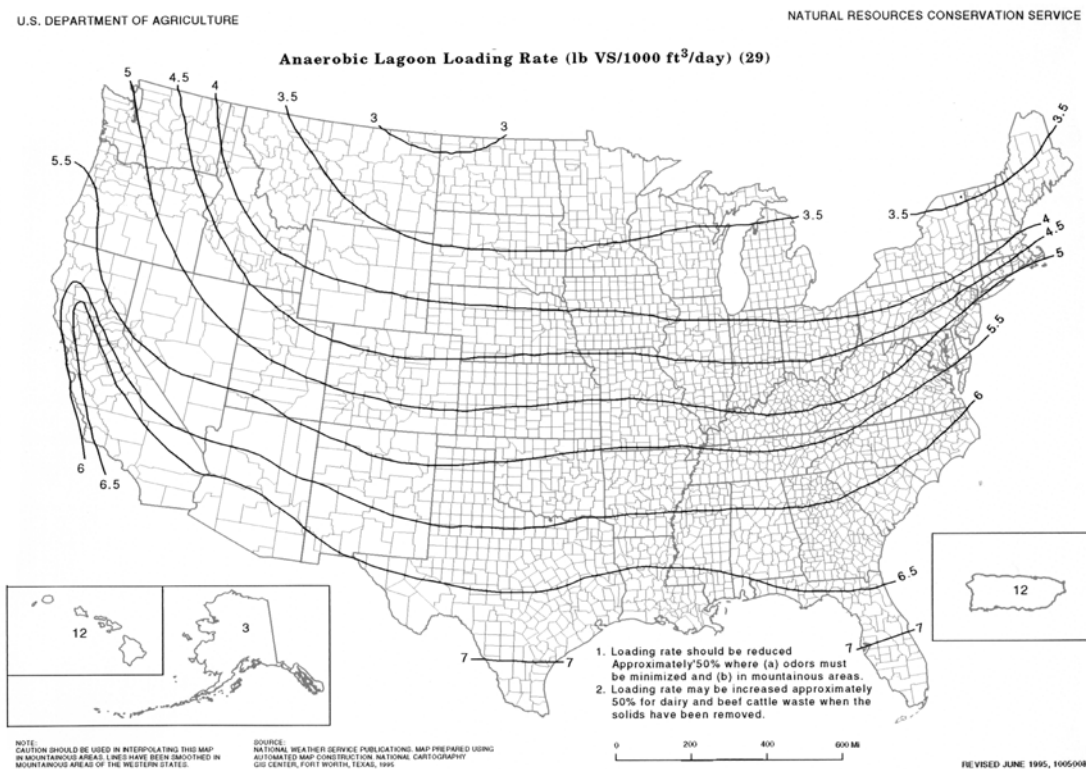


Figure 1. Anaerobic loading rate

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Figure 10-25
Aerobic Lagoon Loading Rate (lb BOD₅/acre/day) (29)

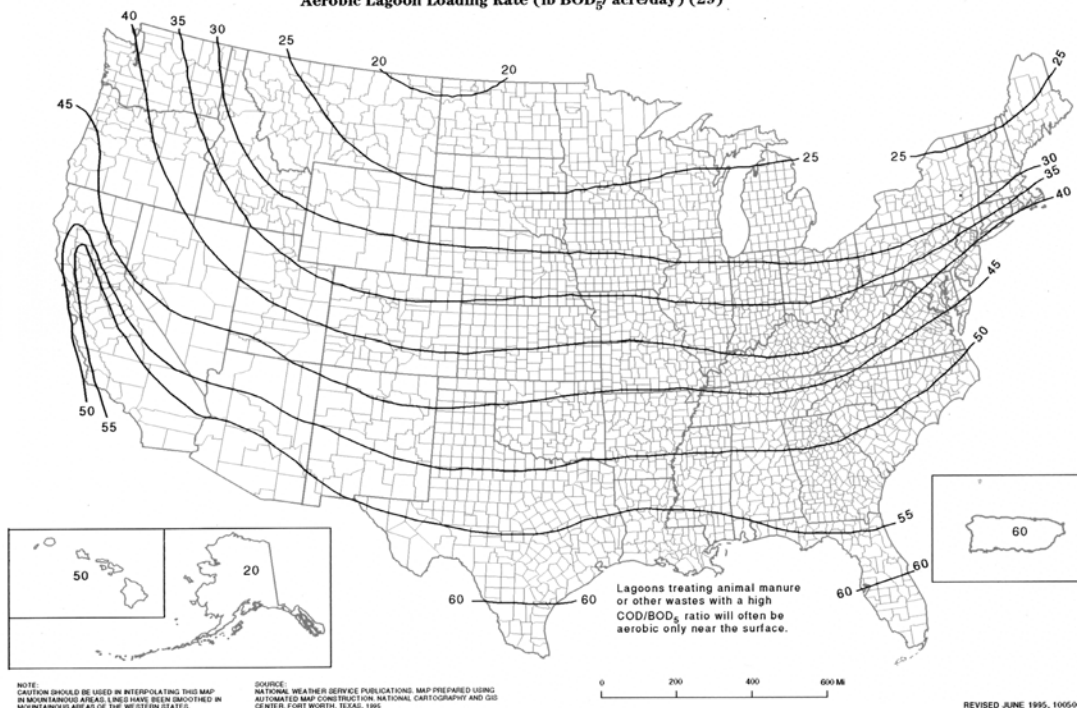


Figure 2. Aerobic lagoon loading rate

Volume

The maximum operating level shall be set to provide the designed loading plus a volume sufficient to store the following:

1. Manure, leachate from silage storage, wastewater, and other wastes accumulated during the storage period.
2. Normal precipitation less evaporation on the surface area of the facility during the storage period.
3. Normal runoff from the facility's drainage area during the storage period.
4. 25-year, 24-hour precipitation on the surface of the facility.
5. 25-year, 24-hour runoff from the facility's drainage area.
6. Residual solids after liquids have been removed. A minimum of 2 feet shall be provided.

7. Additional storage may be required to meet management goals or regulatory requirements.

Mechanically aerated lagoons are designed on the basis of BOD₅ or ultimate BOD loading and on the basis of the equipment manufacturer's performance data for oxygen transfer and mixing. If used for odor control, aeration equipment shall provide a minimum of 0.5-kg (1 lb.) of oxygen for each half kilogram (pound) of BOD₅ contributed daily. For complete treatment, refer to the design procedures provided in the Agricultural Waste Management Field Manual.

The maximum operating level shall be sufficient distance below any automatic outflow device, pipe, or emergency spillway to provide storage for the 25-year, 24-hour precipitation on the lagoon surface. The maximum operating level should be marked with an appropriate staff gage set in the lagoon or by other means to indicate when drawdown is needed.

The minimum operating level after drawdown should normally be that level needed for the design loading except when the lagoon is in drawdown to permit sludge removal or addition of dilution water.

Depth

The minimum depth of liquid shall be 1.8 m (6 ft) for mechanically aerated and anaerobic lagoons and 0.61 m (2 ft) for aerobic lagoons. If subsurface conditions prevent practical construction of anaerobic lagoons to a depth of 1.8-m (6-ft), a lesser depth may be used if volume requirements are met. The site and the equipment dictate the maximum depth for mechanically aerated and anaerobic lagoons. The maximum operating depth for aerobic lagoons shall be 5 ft.

Bottom and edges

The bottom of aerobic lagoons shall be approximately level. The edges of all lagoons below the planned waterline shall be constructed as steep as soil conditions permit to reduce areas of shallow water and to inhibit weed growth.

Earth embankment

The design of the embankment shall conform to the requirements of Practice Standard, 378 Pond.

Inlet

If freezing is not a problem, an open inlet, such as a concrete channel, may be used. If freezing is a problem, the inlet shall consist of a pipe having a minimum diameter of 15 cm (6 in) and a minimum slope of 1 percent, except that a minimum diameter of 10 cm (4 in) may be used for milking center waste. The inlet pipe should terminate a sufficient distance from the shoreline to insure good distribution. It should be far enough below the surface to avoid freezing or be provided with other protective measures. Access should be provided to the pipe for rodding in case of blockage. A water-sealed trap and vent or a similar device shall be provided on pipelines

from enclosed buildings that discharge to enclosed settling tanks or beneath the lagoon surface. Such a device helps to prevent gases from entering the building. Inlet lines shall be made of materials that will not separate at the joints, that will be watertight, and that can withstand sunlight, weather, and earth and traffic loading.

Outlet

Waste treatment lagoons shall not discharge to surface waters unless the owner determines through the state regulatory agency that such discharge will not contravene established water quality standards. Lagoons having a maximum design liquid level of 0.91-m (3 ft) or more above natural ground shall be provided with an emergency spillway or an overflow pipe to prevent overtopping. The crest of the emergency spillway or the invert of the emergency overflow pipe shall be at least 0.31 m (1 ft) below the top of the settled embankment. The emergency spillway, if used, shall have a minimum bottom width of 1.2-m (4-ft). The emergency overflow pipe, if used, shall have a minimum diameter of 15 cm (6 in).

Protection

If the lagoon will create a safety hazard, it shall be fenced and warning signs posted to prevent children and others from using it for purposes other than intended. The embankment and surrounding areas should be vegetated to control erosion. Vegetative screens or other methods should be used to shield the lagoon from public view and to improve visual conditions.

CONSIDERATIONS

Types

Waste treatment lagoons are of three general types-anaerobic, naturally aerobic, and mechanically aerated. Anaerobic lagoons require less surface area than naturally aerobic lagoons but may give off odors.

Naturally aerobic lagoons are relatively odor free. Mechanically aerated lagoons are comparable in size to anaerobic lagoons and are generally odor free, but they require energy for aeration.

Location

The lagoon should be located near the source of waste and as far from neighboring dwellings as practicable, a minimum distance of 91 m (300 ft). If possible, locate the lagoon where prevailing winds will carry odors away from residences and public areas. Runoff from outside drainage areas should not enter the lagoon. The lagoon shall not be located on a flood plain unless it is protected from inundation or damage by a 25-year-frequency flood event.

Solids removal

To reduce sludge buildup, remove solids from waste of animals, such as dairy cattle, fed high roughage rations. A solids trap or a separator may be provided between the waste sources and the lagoon. This may be a concrete or earth structure that can be emptied periodically. A minimum of 7 days storage should be provided, based on a minimum of 23 L (6 gal)/day/horse or cow and 3.8 L (1 gal)/day/sheep or hog, except that a minimum of 3 days storage may be provided for milking center waste. If earth structures are used, a minimum of two should be planned so that one can be dried and cleaned while the other is functioning.

Water Quantity

1. Effects on the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.
2. Variability of the practice's effects caused by seasonal or climatic conditions.
3. Effects of the demand of operation and maintenance on the water supply.

Water Quality

1. Effects on erosion and the movement of sediment, pathogens, and soluble and sediment-attached substances carried by runoff and seepage.
2. Effects of nutrients on surface and ground water quality, particularly the onsite water supply for humans and livestock consumption.
3. Effects on the visual quality of onsite and downstream water resources.
4. Short-term and construction-related effects on the quality of downstream water.
5. Effects on the movement of dissolved substances below the root zone toward ground water.
6. The effects on wetlands and water-related wildlife habitats.

OPERATION AND MAINTENANCE

Operation and maintenance shall be performed according to the written operation plan provided for in the overall waste management plan.

PLANS AND SPECIFICATIONS

Plans and specifications for installing waste treatment lagoons shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

REFERENCES

- USDA Natural Resources Conservation Service, National Agricultural Waste Management Field Handbook.
- USDA Natural Resources Conservation Service, National Engineering Handbook.
- USDA Natural Resources Conservation Service, Engineering Field Handbook (Engineering Field Manual).
- SCS South National Technical Center Engineering Technical Note 716,

Design and Construction Guidelines
for Considering Seepage from
Agricultural Waste Storage Ponds and
Treatment Lagoons.

South National Technical Center Bulletin
S210-4-5, Guidance for use of South
National Technical Center Technical
Note 716.

South National Technical Center
Engineering Technical Note 717,
Measurement and Estimation of
Permeability of Soils for Animal Waste
Storage Facility Design.

MidWest Plan Service Publication 18,
Livestock Waste Facilities Handbook.